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Solar Water Distillation (SWD) Plant Design and Performance Assessment

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ABSTRACT

Pure water is vital for human life. But it's not available and rare in most parts of the world. Pure water is vital for drinking as well as other things such as boiler-making or feeding, filtered water, etc. Therefore, the time demand is purifying water. Water purification is an energy absorbing process, however our normal energy supplies are limited. In this case, alternative renewables will provide us a better option. Solar power is a scientific resource that offers the optimum solutions for this aim. The facility includes two parts fitted for distilling solar water. The top part comprises of glass and a heat absorbing cotton plate. This structure is linked to the right insulator. Below it is a little bottle, condensed clean water in this bottle. The lowest component is cellulite. Wick is included in the box of cellulite. The wick extends from the floor to the rear of the copper plate. The wick gathers the ground water in the presence of a solar fuel and converts it into a glass box. The entire mechanism is tightly airy. It works quite well, however its output is more dependent on the wick. The result of a composite wick material can be enhanced.

KEYWORDS: *Solar Energy, Pure Water, Filters*

I. INTRODUCTION

Energy is the most crucial reality for modern life. Human development accelerates as energy is properly used and converted. Energy is utilised in various ways from earth's initial inception. It is therefore necessary not only to enhance the use process but also to create the conversion process correctly. Enough energy may be saved through conversion by decreasing energy loss.

One of the essential components of life is water, which enhances the chance of survival. About 35% of the globe is immersed in water, yet the major problem is: "How many can be utilised?" In order to utilise water properly, several particular procedures are necessary that can cleanse water in an useable manner. The basic pre-requisite for these innovative techniques is energy resources, however typical energy resources are small due to a severe issue. Therefore, a general method takes time and reduces dependency on traditional oil. As a source of clean energy, solar energy might be the greatest choice. Solar energy may be converted into smart energy sources and is directly employed for this experimental purpose as an energy supply.

For evaluation reasons, a unique structure comprising two parts was designed. The top part of the panel consists of a glass with a copper plate and a composite wrap material. A small tunnel can be used to condense water to the appropriate spot. The lowest part consists of a small cubic box with wicks. This lower section is linked to the top and extended to the ground. This design guarantees a climate that is airtight.

The most essential element of this setup is the wick that functions as a crude water absorber.

Wick material absorbs water from a specific depth and increases it. Capillary and surface tension are the most crucial qualities for the choosing of a wick material. Also crucial is the composition of the wick material, without which the absorption qualities of the wick material change. For this investigation, special composition of the wicks is employed to get better outcomes.

Solar Water Plant is an underwater purification system that filters the water without the use of toxicity, power, waterborne infections, climate effects and deforestation, and CO2 emissions. Solar heating is used to heat the glass wick content and water is also evaporated from the wick. The evaporated water condensed in a chilly place. The wick's capillary action tends to elevate the water underneath. Capillarity, capillarity or wicking are two phenomena: first, liquid migration through thin tubes, and second, fluid movement through poreous media, such as water through the earth. Capillary action results from adhesion and surface tension. The surface tension is employed to maintain a stable surface and the entire liquid surface is pulled up instead of simply pushing the borders up. The combined forces of fluid molecules are the cause of the so-called surface tension. The surface pressure is derived from the polar property of the water molecule. The attraction of water moles to soil particles is determined by hydrological capillary activity. Capillary action transports soil wetland drainage to dry areas. Potential soil fluctuations (speech m) cause capillary soil activity. The choice of a wick material is highly significant and critical. Therefore, the composition of material that has high absorption properties in comparison to other typical wicks is vital to concentrate. Strong absorbing qualities of local winds include natural fibre such as black glass fibre, fibrous polyurethane thread, nylon clothesline, polyester string. [1][3][4][5][6][7].

II. Experimental Work

The equipment is under the sun's beam. The light penetrates the apparatus and water evaporates. Evaporation is the process of converting a liquid material into the gas phase. Contrary to that, condensation occurs when the gas returns to liquid form. In order to evaporate, the liquid has to obtain sufficient energy to stimulate the molecules to go farther. The energy often originates from heat. Figure 1 shows the basic solar water farm concept. The basic concept of solar operation is still Solar energy warms up water, evaporates water (salt and microorganisms left behind) and condenses as rains to the soil.

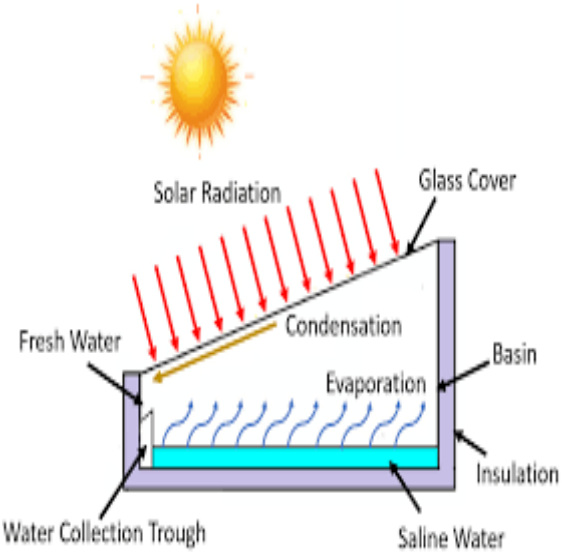

Figure 1: Model diagram of a solar distillation plant

In this experimental design, two essential components are particularly significant. The upper section is constructed of glass in order to provide the greenhouse effect. Figure 1 shows the top of the roof or glass box. Underneath this glass enclosure lies a copper plate. Since copper is an extremely powerful thermal media, heat may be uniformly transferred. The wicks are placed under a board of copper. The lowest component is cellulite. The wick extends from the top glass box through the cellulite box to the ground water source. The sun shines inside the window, and so forth. At this moment, the copper plate is heated. Under the copper board, the hot copper board heated the wick. The wick then vaporises the waters and the vapour leaves the wick. When water evaporates, the water vapour rises and the glass surface condensate is collected in Figure 1 and Figure 2. This technique both avoids impurity and destructs microbiological organisms. Water is ultimately cleaner than rainwater[2]. The water to be cleaned is put into the reservoir to partially fill the reservoir. The glass cover enables the sun to enter the silence, which is largely absorbed by the dark foundation. This inside surface employs a darkened substance to enhance sunlight absorption. Water starts to heat up and the air between the water surface and the glass cover rises in moisture content. The heated water vapour evaporates from the bottle and condenses on the glass cover within. The salts and bacteria in the original water are therefore left behind. The condensed water flips down the sloped glass pan into an inside cupboard and into a storage bottle.

Figure 2: Solar distillation plant

III. Results and Discussion

The sun shine can affect the effectiveness of the solar water distillation plant. Measurement generally performed on a solar day basis. Solar energy may be used in table 1 and table 2 for 8 hours each day. The thermal efficiency of the distillation system is determined by the collector water level. The temperature of the water, the internal air, the glass (both inside and outside) and the variations between these factors directly affect the solar distiller's thermal efficiency. Figure 3 shows the temperature and efficiency curve.

Table 1: Mass flow rate in lt/m²

Time (hour)	Collected Water (Lts)	Area (m2)	Mass flow rate (Lts/m2/4 hour)
4	0.125	0.15	1.25
4	0.145	0.15	1.11
4	0.156	0.15	1.20
4	0.138	0.15	1.15
4	0.116	0.15	1.35

Table 2: Efficiency (%)

Solar intensity (W/m2)	Solar power(W)	Efficiency (%)
990	111.625	17.90
1200	134.584	14.62
1250	142.56	18.24
1100	125.23	16.98
1000	121.525	19.16

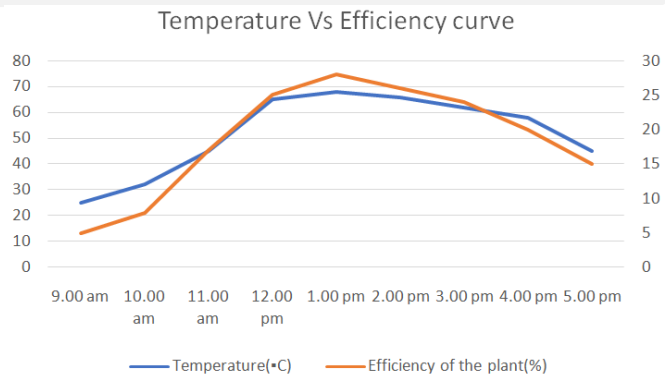

Figure 3: Temperature Vs Efficiency Curve

IV. Conclusion

It is an efficient water softening method, it is a cheap way to tap the water with solar power and may be reused. The solar distillery performance has been satisfactorily accomplished during the experimental period. The graph shows that the temperature increase is highest during the time from 11 am to 1:30 pm. The maximum attainable temperature is 70.oC at 14.00. Then the temperature drops. The objective of the experiment was to obtain clean water from the brackish water. The brackish water provided was 20 litres and we had 2 litres at the conclusion of the trial. The achieved TDS level of filtered water is 75 PPM with drinking water. The system efficiency is 10-30 per cent depending on the day's sunshine.

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